

Impacts of Drought on Streamflow, adult Chinook Salmon Migration and Smolt Production in Redwood Cr

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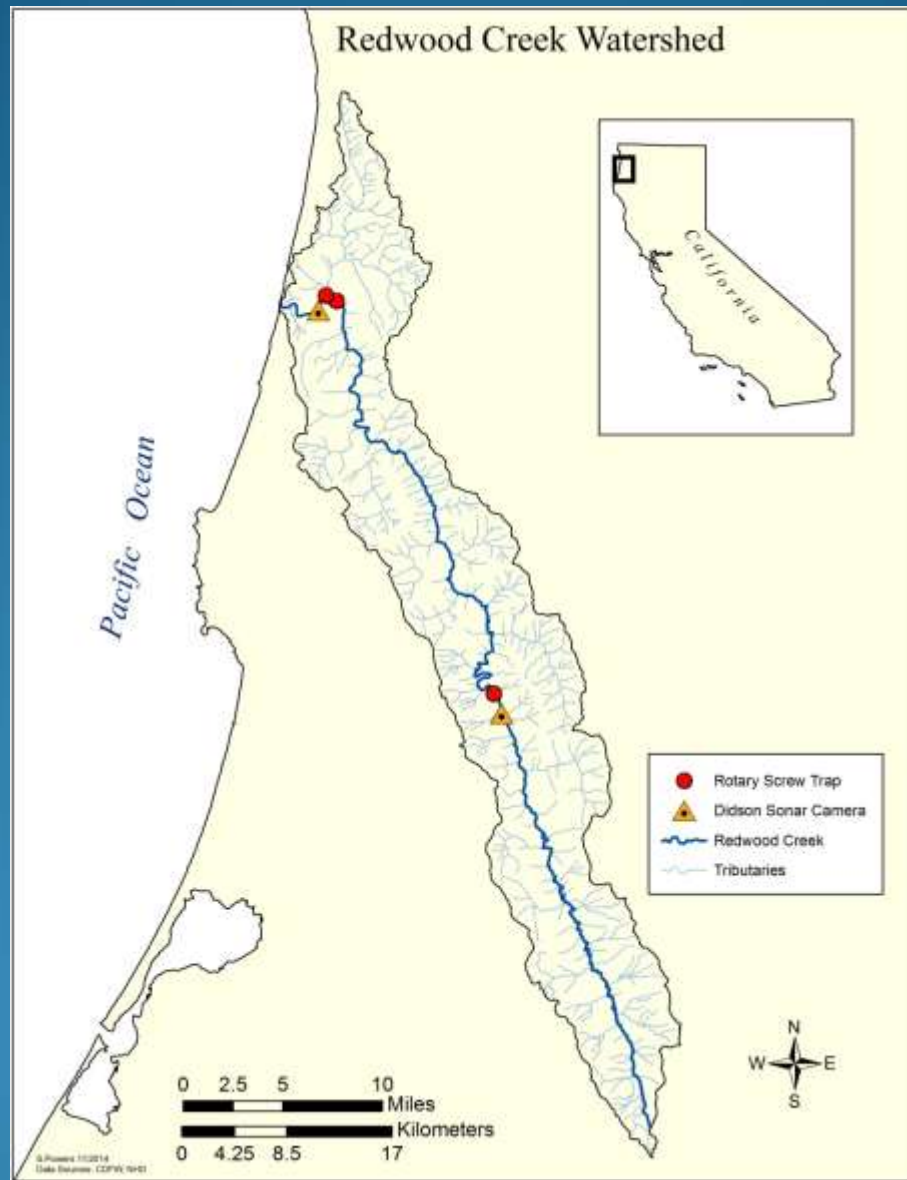
Introduction

- California has experienced recent drought conditions beginning in 2012 to at least 2014.
- The focus on this presentation is to compare adult Chinook salmon abundances and smolt output in WY's 2013 and 2014.
- Long term data sets are necessary to detect as much biological and environmental variability as possible.
- In addition, multiple study sites within a given river/stream (eg Redwood Cr) are needed to address specific questions.
 - Studies need to focus on adult and smolt stages.

Fisheries Studies in Redwood Cr

- Sonar adult counts
- Redd surveys/carcass counts (adults)
- Smolt population estimates (3 traps)
- Overwinter survival (coho salmon)
- Juvenile coho salmon distribution
- Juvenile salmonid abundance/growth in estuary

Site Description



Chinook Salmon Life History in Redwood Cr basin

- Adult Chinook salmon enter Redwood Cr from Sept/October – January
 - First entry dependent upon when mouth opens to Pacific Ocean.
- Ocean-type smolts dominate, stream type relatively rare: 99.9% vs 0.1%
 - Migrate from March – August.
 - Peak month can be April, May, June, or July

Methods

- **Stream discharge data was collected on-line from USGS gages in upper Redwood Cr (O'kane) and lower Redwood Cr (Orick).**
 - **Data for WY 2014 is preliminary.**
- **The sonar camera in lower Redwood Cr produced adult escapement estimates for 2012/13 and 2013/14.**
- **The sonar camera in upper Redwood Cr provided adult escapement estimates for 2013/14 (first year of operation).**
- **Three smolt traps operate within the Redwood Cr basin: mid to upper RC (15 yrs), lower RC (11 yrs), and lower Prairie Cr (4 yrs).**

Methods

- The sonar camera in lower Redwood Cr (Rm 3.2) operates from Sept/Oct – May.
- The sonar camera in upper Redwood Cr (RM 34) operates year round.
- The three smolt traps operate from late March/early April – August or September
 - 24 hrs/d, 7d/wk.
 - Mark/recapture used for population estimates.

Adult Chinook Salmon



Sonar camera



Lower Redwood Cr



Mid to upper RC





Chinook Salmon Smolts



Smolt Traps (mid to upper RC)



Lower RC



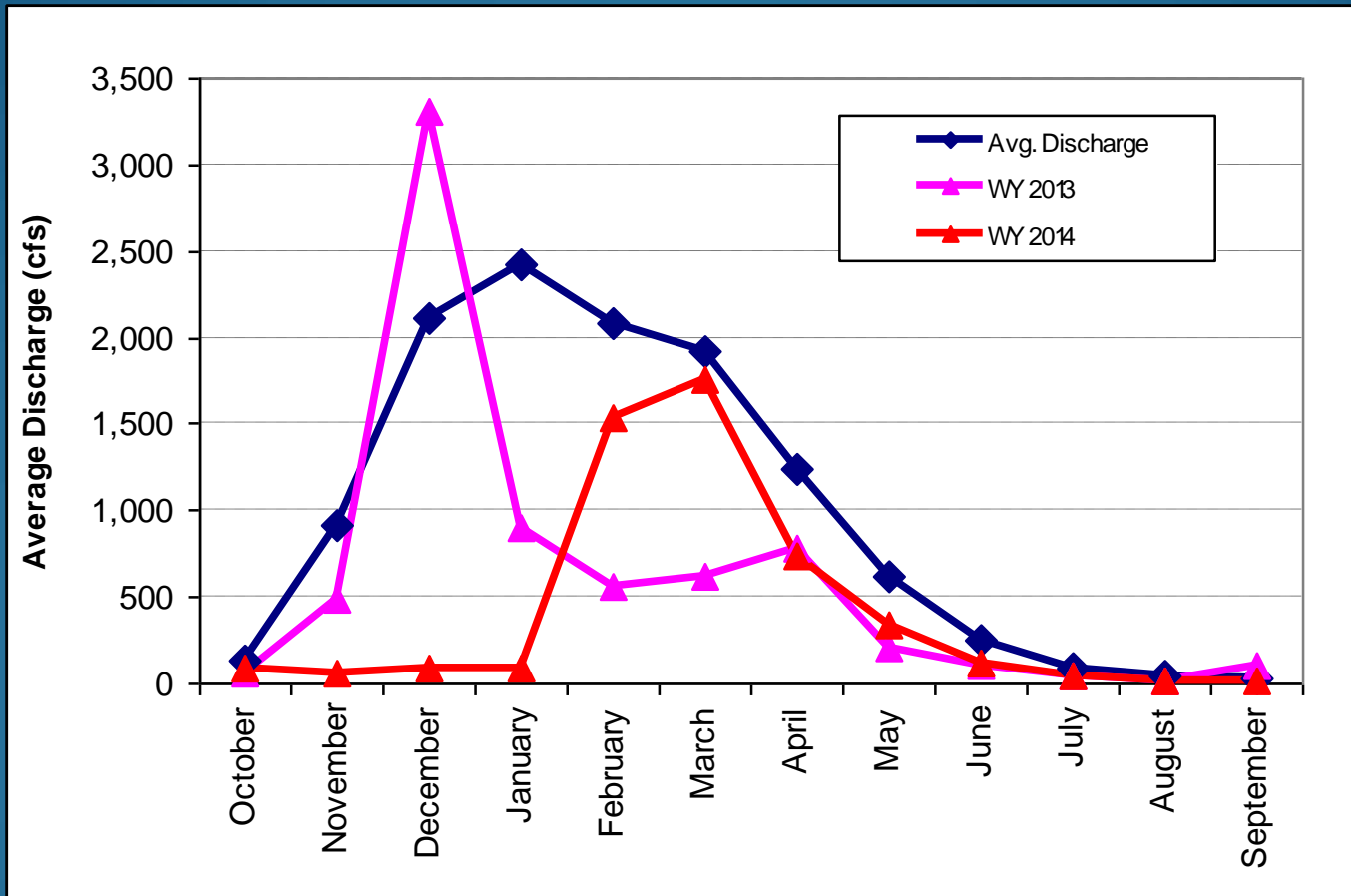
Lower Prairie Cr



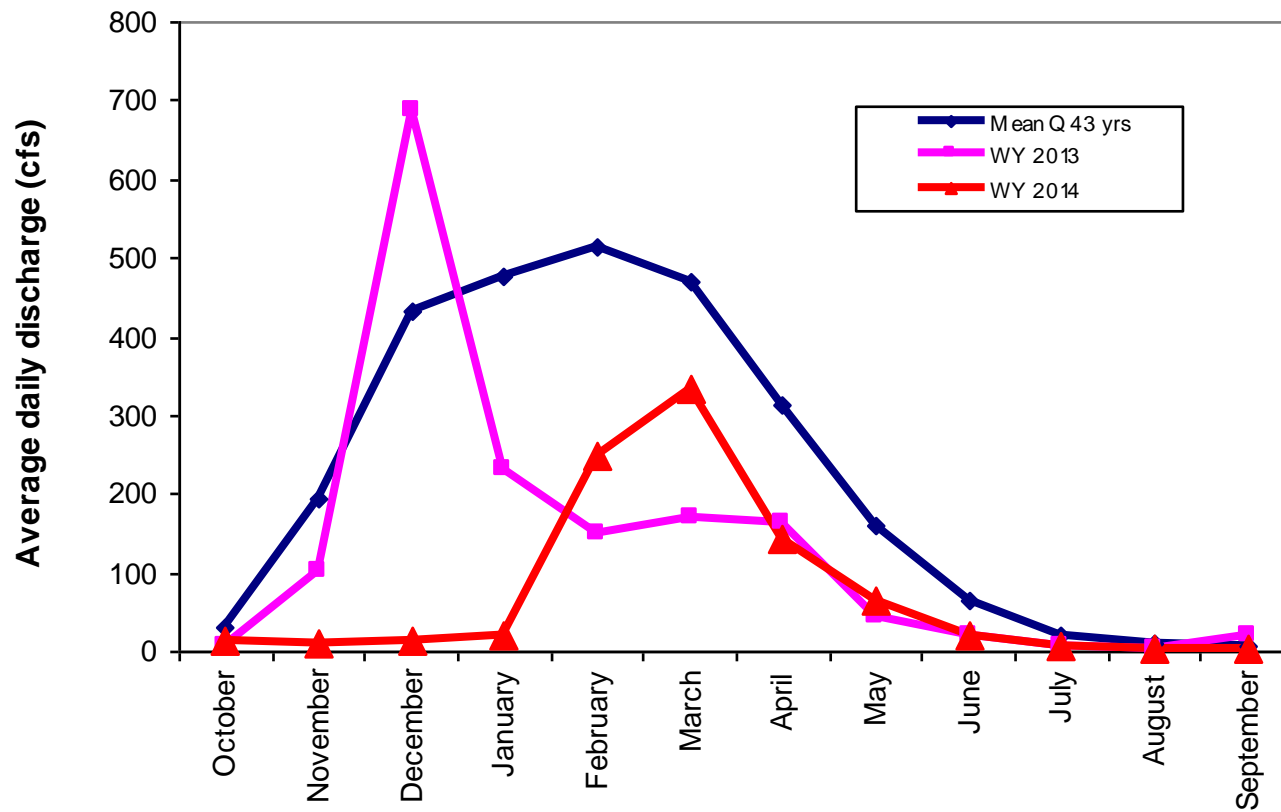
Results

- Average daily discharge in WY 2013
 - Lower Redwood Cr = 600 cfs (39% < Avg)
 - Upper Redwood Cr = 134 cfs (40% < Avg)
- Average daily discharge in WY 2014
 - Lower Redwood Cr = 407 cfs (59% < Avg)
 - Upper Redwood Cr = 73 cfs (67% < Avg)

Lower Redwood Cr



Upper Redwood Cr



Avg daily cfs Oct - January

- WY 2013
 - Lower RC = 1,190 cfs (15% < Avg)
 - Upper RC = 258 cfs (9% < Avg)

Avg daily cfs Sept - January

- WY 2014
 - Lower RC = 83 cfs (93% < Avg)
 - Upper RC = 15 cfs (93% < Avg)

Year 2012/13

- **Lower Redwood Cr:**

- Sonar counts of adult Chinook salmon = 3,200
- Smolt Abundance in lower Redwood Cr = 566,859*
- Smolt abundance in lower Prairie Cr = 96,817*
- Total smolt abundances for basin = 663,676
- Smolts/adult = 207

- **Upper Redwood Cr:**

- Sonar counts of adult Chinook salmon = N/A, > 500 adults*
- Smolt Abundance = 680,747*

Year 2013/14

- Lower Redwood Cr:

- Sonar counts of adult Chinook salmon = 3,500
- Smolt Abundances in lower Redwood Cr = 209,005
- Smolt abundances in lower Prairie Cr = 15,179
- Total smolt abundances for basin = 224,184
- Smolts/adult = 64

- Upper Redwood Cr:

- Sonar counts of adult Chinook salmon = 84
- Smolt Abundances = 3,470
- Smolts/adult = 41

Effects due to drought

- **The reduction in smolt output in the lower basin in 2014 compared to 2013 was 439,432 smolts or 66%, even though there were 300 more adults in 2013/14.**
 - In 2014, we had 99% less smolts emigrating from mid-upper RC compared to 2013 and the previous 14 yr average (Avg = 238,379).
- **Basin-wide smolts/adult in 2014 (64) was much less than in 2013 (207).**

Effects due to drought

- **The percentage of fry (FL < 45 mm) in the smolt population passing through lower Redwood Cr in 2014 was 35% compared to 22% in 2013. Average of years 2004-2013 is 8%.**
 - Fry have lower smolt to adult survival than fingerlings, unless they can make up size differences in the estuary (unlikely).

Low smolts/adult in mid-upper RC in 2013/14

- Later than usual arrival timing and spawning.
- Restricted spawning areas.
- Low number of adults per stream mile (2.3 adults/mi).

Low smolts/adult in lower RC in 2013/14

- Adult fish were forced to spawn in areas downstream of mid-upper RC.
- Spawning habitat has higher concentrations of fine sediments than upper basin.
 - Reduction in egg to emergent fry survival.

Conclusions

- WY's 2013 and 2014 were both 'drought' water years.
- Droughts obviously reduce streamflow, however the severity and timing of dry periods is more important.

Conclusions

- In WY 2013, we experienced record numbers of Chinook salmon smolts at three locations within the basin.
- In WY 2014, drought conditions were so severe that few adult Chinook salmon entered mid-upper Redwood Cr.

Conclusions

- When adults cannot reach mid-upper Redwood Cr, basin-wide smolt production can be reduced by as much as 66%.
- Redd gravel conditions in mid to upper Redwood Cr are much better than mid to lower Redwood Cr.

Conclusions

- Mid to upper Redwood Creek is *very* important for basin wide smolt production.
- When adults spawn lower in the system, young-of-year migrants have less time for growth, and the percentage of fry can be higher.

- Long term studies (adults, smolts) with multiple study sites are necessary to address biological and environmental variability.
- These studies can provide empirical data for answering specific questions regarding drought, migration, survival, and population abundances.

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Thank You!

